International Journal of Medical, Medicine and Health Sciences
ISSN: 2517-9969
Vol:4, No:5, 2010

Research on Applying the Continuity Care Document to Generate a Medical Record with Entry Level

Hsing-Yi Kao, Der-Ming Liou

***Abstract*—**Transferring patient information between medical care sites is necessary to deliver better patient care and to reduce medical cost. So developing of electronic medical records is an important trend for the world.The Continuity of Care Document (CCD) is product of collaboration between CDA and CCR standards. In this study, we will develop a system to generate medical records with entry level based on CCD template module.

***Keywords*—**Continuity Care Document, medical record, entry level

I. Introduction

TRANSFERRING patient information between medical care sites is necessary to deliver better patient care [1, 2] and to reduce medical cost [3]. So developing of electronic medical records is an important trend for the world.

In the actually status, the HL7 Clinical Document Architecture (CDA) is currently most widely used international standards for electronic medical records [4, 5]. But implementing CDA is too difficult because it is complexity information model, and has enormous data types with entry level to machine readable [6, 7].

In addition to the above, another problem is too many different formats in clinical records used by hospitals in Taiwan. How to integrate and mapping that into an international medical record standard is a big challenge. And to make the machine readable is the most difficult of the challenge. So to choose an international standard that transmission of medical data for improving interoperability between the heterogeneous systems is very important.

The HL7 Clinical Document Architecture (CDA) is a document markup standard that specifies the structure and semantics of clinical documents for the purpose of exchange. From its inception, CDA has supported the ability to represent professional society recommendations, national clinical practice guidelines, and standardized data sets. From the perspective of CDA, the CCR is a standardized data set that can be used to constrain CDA specifically for summary documents [8].

Der-Ming Liou is with the Institute of Biomedical Informatics, National Yang-Ming University, Taiwan (corresponding author to provide phone: 886-2-28267000-6170; fax: 886-2-2820-2508 e-mail: dmliou@ym.edu.tw).

Hsing-Yi Kao is with the Institute of Biomedical Informatics, National Yang-Ming University, Taiwan (e-mail:s80241@gmail.com)..

The CCR is a core data set of the most relevant administrative, demographic, and clinical information facts about a patient's healthcare, covering one or more healthcare encounters. It provides a means for one healthcare practitioner, system, or setting to aggregate all of the pertinent data about a patient and forward it to another practitioner, system, or setting to support the continuity of care. The primary use case for the CCR is to provide a snapshot in time containing the pertinent clinical, demographic, and administrative data for a specific patient [9].

The resulting specification, known as the Continuity of Care Document (CCD), is developed as a collaborative effort between ASTM and HL7. It is intended as an alternate implementation to the one specified in ASTM ADJE2369 for those institutions or organizations committed to implementation of the HL7 Clinical Document Architecture.

II. Objective

The Continuity of Care Document (CCD) is product of collaboration between CDA and CCR standards [8]. It is provide a clear guideline to implementing a medical record with entry level. In the Robert H. Dolin, Klaus-Hendrik WOLF and Bengisu Tulu individual study, they refer the CCD model to define their document. And suggest the CCD can support their requirement [10, 11, 12]. In Shobha Phansalkar study, they successfully mapped 94% of medication entries and greater than 92% of medication component mappings to CCD constraints [13]. So the CCD offers a large step towards the goal of interoperability among EHRs.

In this study, we will develop a system to generate medical records with entry level based on CCD template module. To provide a system for user to generate the records with entry level more easily. And it is according the international standard to achieve intercommunicate medical information.

III. method

The method of this study is separate the two part. The first stage, we need to choose and research the medical record standard. Map the standard with local clinical requirement in Taiwan. And the second stage, we follow the standard to design the system.

A. Usage of Standards

We have sufficient reason of thinking that CCD is suitable standard for this study. Because the CCD is defined a clear

guideline and example to implementing a CCD record with entry, and it accorded CDA mechanism to define 38 templates (Tables 1). In addition to assigning a template identifier to the overall implementation guide, this document assigns template identifiers to other patterns, such as document sections and specific clinical statements within document sections. Using the templateId to reference one of these patterns indicates that the CDA instance conforms to the constraints specified in that pattern.

In our system will base on the CCD templates identifiers to design the system interface module. Beforehand, we imitate a medical record, the format actual used to long term care in Taiwan, map the record data to CCD standard. That is want to confirm that CCD is suitable be the medical record standard in Taiwan.

TABLE 1
SUMMARY OF CCD TEMPLATE IDENTIFIERS
(EXTRACTED FROM HL7 IMPLEMENTATION GUIDE: CDA RELEASE 2 – CONTINUITY OF CARE DOCUMENT.)

Template Identifier	Description
2.16.840.1.113883.10.20.1	CCD v1.0 Templates Root
Section Templates	
2.16.840.1.113883.10.20.1.1	Advance directives section
2.16.840.1.113883.10.20.1.2	Alerts section
2.16.840.1.113883.10.20.1.3	Encounters section
2.16.840.1.113883.10.20.1.4	**Family history section**
2.16.840.1.113883.10.20.1.5	Functional status section
2.16.840.1.113883.10.20.1.6	Immunizations section
2.16.840.1.113883.10.20.1.7	Medical equipment section
2.16.840.1.113883.10.20.1.8	**Medications section**
2.16.840.1.113883.10.20.1.9	Payers section
2.16.840.1.113883.10.20.1.10	Plan of care section
2.16.840.1.113883.10.20.1.11	**Problem section**
2.16.840.1.113883.10.20.1.12	Procedures section
2.16.840.1.113883.10.20.1.13	Purpose section
2.16.840.1.113883.10.20.1.14	**Results section**
2.16.840.1.113883.10.20.1.15	**Social history section**
2.16.840.1.113883.10.20.1.16	**Vital signs section**
Clinical Statement Templates	
2.16.840.1.113883.10.20.1.17	Advance directive observation
2.16.840.1.113883.10.20.1.18	Alert observation
2.16.840.1.113883.10.20.1.19	Authorization activity
2.16.840.1.113883.10.20.1.20	Coverage activity
2.16.840.1.113883.10.20.1.21	Encounter activity
2.16.840.1.113883.10.20.1.22	**Family history observation**
2.16.840.1.113883.10.20.1.23	**Family history organizer**
2.16.840.1.113883.10.20.1.24	**Medication activity**
2.16.840.1.113883.10.20.1.25	Plan of care activity
2.16.840.1.113883.10.20.1.26	Policy activity
2.16.840.1.113883.10.20.1.27	**Problem act**
2.16.840.1.113883.10.20.1.28	**Problem observation**
2.16.840.1.113883.10.20.1.29	Procedure activity
2.16.840.1.113883.10.20.1.30	Purpose activity
2.16.840.1.113883.10.20.1.31	**Result observation**
2.16.840.1.113883.10.20.1.32	**Result organizer**
2.16.840.1.113883.10.20.1.33	**Social history observation**
2.16.840.1.113883.10.20.1.34	Supply activity
2.16.840.1.113883.10.20.1.35	**Vital signs organizer**
Supporting Templates (used within a clinical statement)	
2.16.840.1.113883.10.20.1.36	Advance directive reference
2.16.840.1.113883.10.20.1.37	Advance directive status observation
2.16.840.1.113883.10.20.1.38	**Age observation**
2.16.840.1.113883.10.20.1.39	**Alert status observation**
2.16.840.1.113883.10.20.1.40	**Comment**
2.16.840.1.113883.10.20.1.41	**Episode observation**
2.16.840.1.113883.10.20.1.42	**Family history cause of death observation**
2.16.840.1.113883.10.20.1.43	**Fulfillment instruction**
2.16.840.1.113883.10.20.1.45	**Location participation**
2.16.840.1.113883.10.20.1.46	**Medication series number observation**
2.16.840.1.113883.10.20.1.47	**Medication status observation**
2.16.840.1.113883.10.20.1.48	**Patient awareness**
2.16.840.1.113883.10.20.1.49	**Patient instruction**
2.16.840.1.113883.10.20.1.51	**Problem healthstatus observation**
2.16.840.1.113883.10.20.1.50	**Problem status observation**
2.16.840.1.113883.10.20.1.53	**Product**
2.16.840.1.113883.10.20.1.52	**Product instance**
2.16.840.1.113883.10.20.1.54	Reaction observation
2.16.840.1.113883.10.20.1.55	Severity observation
2.16.840.1.113883.10.20.1.56	**Social history status observation**
2.16.840.1.113883.10.20.1.57	**Status observation**
2.16.840.1.113883.10.20.1.44	Status of functional status observation
2.16.840.1.113883.10.20.1.58	Verification of an advance directive observation

B. System design

The CCD document is defining 17 sections and 38 templates; it was designed for long term care. So the section is including a lot part of the clinical event. In this study, the first stage of system design scope will delimit to implement “visit note”. To design the system for generate visit note, we chose the required section of the 17 section. That is *“Family history section”,” Medications section”,” Problem section”,” Results section”,” Social history section”,” Vital signs section”*. And in these sections should include some section templates, clinical statement templates, and supporting templates. These templates list was be bold on the Table 1.

The system architecture is reference to a study that about standard-based report form design system [14]. Our system followed the three-tiered architecture (the first is data tier, second tier is about logic, third is presentation tier), the system was implemented in the JAVA programming language. Several well-known open source frameworks and database are chosen instead of other proprietary copyrighted software products. That is because low cost, less dependence on vendors, easier to customize, and overall better openness. Moreover, making use of these frameworks minimizes the need for developing infrastructure so that programmers could devote more time to the application’s business logic to fulfill the requirements.

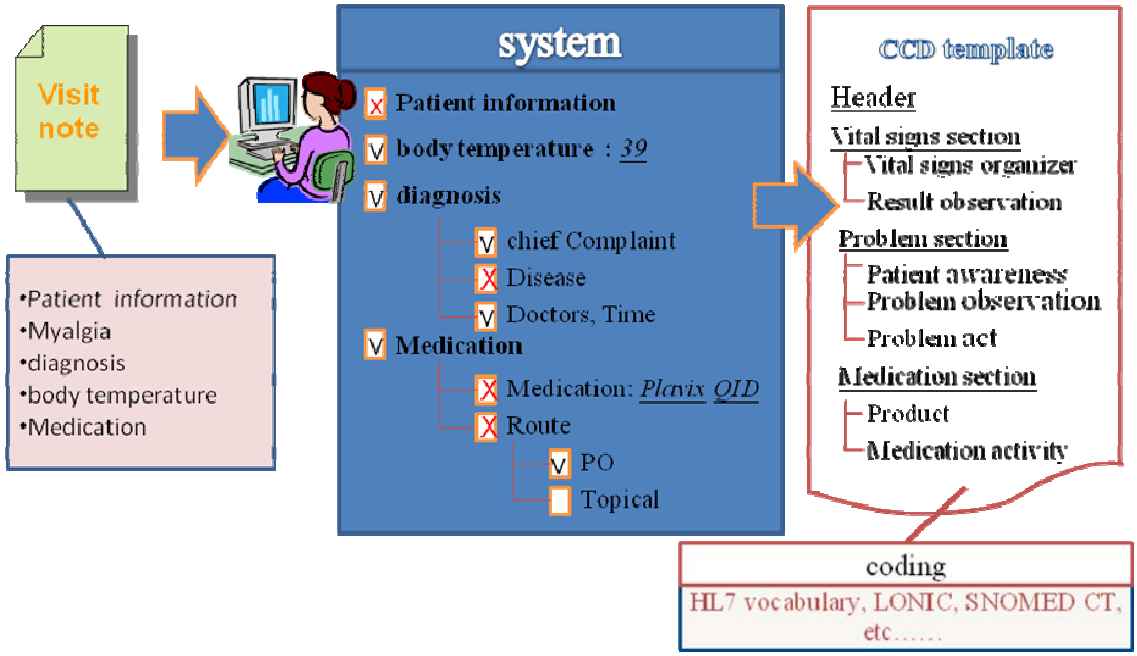

Fig. 1 System design

Base on those CCD templates, the system design to generated a visit note that follow the CCD standard, and it is a XML format with entry level. For an example situation, if a patient is feel uncomfortable and go to the hospital. The hospital stuff can record the medical event requirement to select the item in system interface. And the system processer will to map the suitable template to generate a XML medical record (figure 1).

IV. Result

Preliminary result, we successfully mapped the long term care record to CCD standard and implemented a XML document. And the XML document can be validated by CCD and schematron validator. The figure2 is it transformed with an XSL processor using an XSL-T stylesheet to the final CCD document. The patient data is fictitious accord with the actual clinical event simulation in Taiwan. We mapped the record into the nine sections, and implemented the complete XML schema include entry level. The figure3 is showing a part entry schema of encounter section. And we also define a quickly implementation guide for long term care in Taiwan. In the guide, we define a lot of part of the message type, element and event code. And provide the message code list that most be used and suitable code in Taiwan. It is Chinese language, easily to understand, and provide a guideline to the tyro implement CCD easily.

Base on the preliminary result, we had most understanding of the constraint with the overall structure of CCD standard, especially the entry level. We were programming the templates that required in this study to be modular, and to define the message type and code of every template module. The figure 4 shows the problem observation template module. The schema was be bold indicates the code was defined and will automatically bring out the data; the schema with underline is the optional field that accord user enter. And the system will be base on those template modules for user to generate the records with entry level more easily. And it is according the international standard to exchange. The record generated by the CCD system is a XML document. In the document body section, it is record complete entry level data, and can be validation on XML and schematron validator.

V. Discussion

In the CCD entry level has enormous data types and different coding system be used. There are International Classification of Diseases, Ninth Revision, and Clinical Modification (ICD-9-CM) code, Logical Observation Identifiers Names and Codes (LOINC), Systematized Nomenclature of Medicine (SNOMED), RxNorm and so on. In CCD standard, it is most used LOINC to indicate the section code, RxNorm to indicate the medication information, SNOMED to indicate the clinical event and medical equipment information, ICD-9-CM to indicate the diagnosis result and disease. But these coding systems are not widespread adopt in Taiwan. Those coding systems and Taiwan local coding systems map that is important work on the further.

In the same case of the coding system problem, in our preliminary result that map long term care record to CCD standard. In the social history section have the same problem, we can not find the suitable code to indicate the disabled level that defined by Taiwan policy, and the same problem also in catastrophic illness level. So in the social history section, we didn't implement to entry level. That is limitation of this study.

電子照護記錄摘要

產生日期：April 7, 2009

個案姓名：陳小小　　身分證字號：A123456789
出生年月日：August 31, 1981　　性別：女
地址：203台灣基隆市188號2樓　　電話：Tel: (02) 12345678
緊急聯絡人：陳大同　22225555　父親
張秀珠　22225555　母親

Table of Contents

- 病人生活史(Social History)
- 醫療保險(Payers)
- 評估資料(Functional Status section)
- 傷病診斷資料(Problems)
- 藥事安全服務(Medications) 處方箋 20070520
- 藥事安全服務(Medications) 處方箋 20070824
- 管路評估(Medical Equipment)
- 生理量測資料(Vital Signs)
- 服務通用記錄(Encounters)

病人生活史(Social History)

項目	內容	評估日期	有效期限
身份別	低收入戶	20060630	20080630
重大傷病		20050304	
身障手冊	重度	20050902	20080902

醫療保險(Payers)

保險補助單位	保險類型/保險內容	保險單號	補助項目
里光人壽	私人保險/意外險	14d4a520-7aae-11db-9fe1-0800200c9a66	Kummell's disease壓迫性脊椎骨折

Fig. 2 The result picture by transformed with an XSL processor using an XSL-T stylesheet

```
<component>
   <section>
   <templateId root="2.16.840.1.113883.10.20.1.3"/>
   <code code="46240-8" codeSystem="2.16.840.1.113883.6.1"
codeSystemName="LONIC" displayName="History of
hospitalizations+History of outpatient visits " />
   <title>服務通用記錄(Encounters)</title>
<!-- level 2-->
   <text>
   <table border="1" width="100%">
   <thead>
   <tr>
     <th>服務項目</th>
      <th>使用日期</th>
      <th>服務內容</th>
      <th>結果</th>
      <th>備註說明</th>
   </tr>
   </thead>
   <tbody>
   <tr>
      <td>遠距視訊會診</td>
      <td>20070430</td><td>與台大醫院骨科李具嫌醫師會診
</td>
      <td>完成</td>
      <td>&amp;#160;</td>
      </tr>
   </tbody>
   </table>
</text>
<!-- level 3-->
<entry typeCode="DRIV">
   <encounter classCode="ENC" moodCode="EVN">
         <templateId root="2.16.840.1.113883.10.20.1.21"/>
       <code code="VR" codeSystem="2.16.840.1.113883.5.4"
      codeSystemName="ActCode" displayName="Virtual">
   <originalText>遠距視訊會診</originalText>
</code>
 <statusCode code="completed" />
   <effectiveTime value="20070430"/>
     <participant typeCode="RML">
         <templateId root="2.16.840.1.113883.10.20.1.45"/>
   <participantRole classCode="ROL" >
     <id extension="D005" root="2.16.886.111.100000.100000.2"
/>
   <playingEntity classCode="PSN" >
     <name>李具嫌
      <prefix>骨科醫師</prefix>
      </name>
    </playingEntity>
   </participantRole>
  </participant>
 </encounter>
 </entry>
</section>
</component>
```

Fig.3 XML schema of encounter section

```
<!-- Problem observation template -->
   <observation classCode="OBS" moodCode="EVN">
   <templateId root="2.16.840.1.113883.10.20.1.28"/>
    <code code="ASSERTION"
codeSystem="2.16.840.1.113883.5.4"
codeSystemName="ActCode" />
   <statusCode code="completed"/>
    <effectiveTime value="20070531(time)" />
   <value xsi:type="CD" code="714(diagnosis code)"
codeSystem="2.16.840.1.113883.6.1"
codeSystemName="ICD-9" displayName="Rheumatoid
arthritis( displayName)"/>
    </observation>
```

Fig.4 Problem observation template module schema

VI. CONCLUSION

Exchange and interoperability the medical information is an important trend for the world. If want to achieve this object, the top point is that medical record can accomplish the machine readable. So the entry level of medical record is an important part in this object.

In this study, we define a quickly implementation guide and developing a system to generate medical records with entry level based on CCD standard. The CCD standard is an international standard, so we hope this study can be a pilot study of international medical record standard that with entry level in Taiwan.

REFERENCES

[1] McDonald CJ, "The barriers to electronic medical record systems and how to overcome them." *Journal of the American Medical Informatics Association*, vol.4, pp 213-221, 1997
[2] Huang EW, Hsiao SH and Liou DM , "Design and implementation of a web-based HL7 message generation and a]validation system." Int J Med Inform, vol. 70, pp. 49-58.,2003
[3] Yasnoff WA, Humphreys BL, Overhage JM, Detmer DE, Brennan PF, Morris RW, Middleton B, Bates DW, Fanning JP, "A consensus action agenda for achieving the national health information infrastructure," *Journal of the American Medical Informatics Association*, vol. 11, no. 4, pp. 332-338, July-August 2004.
[4] Health Level Seven: http://www.hl7.org/
[5] Huang Yonga, Guo Jinqiub, Yoshio Ohta, "A Prototype Model Using Clinical Document Architecture (CDA)with a Japanese Local Standard : Designing and Implementing a Referral Letter System", Acta Med. Okayama, Vol. 62, No. 1, pp. 15-20, 2008.
[6] Sungwon Jung, Jinwook Choi, "Generation of Level 3 CDA document using CDA Studio", IEEE, 2007.
[7] WALTER V. SUJANSKY, MD, PHD, J. MARC OVERHAGE, MD, PHD, SOPHIA CHANG, MD, MPH,JONAH FROHLICH, MPH, SAMUEL A. FAUS, MS, " The Development of a Highly Constrained Health Level 7 Implementation Guide to Facilitate Electronic Laboratory Reporting to Ambulatory Electronic Health Record Systems", Journal of the American Medical Informatics Association Vol. 16 No. 3, pp285-290, 2009.
[8] Health Level Seven Document- Continuity of Care Document : http://www.hl7.org/documentcenter/public/pressreleases/20070212.pdf
[9] American Society for Testing and Materials: http://www.astm.org/
[10] Robert H. Dolin, Gay Giannone, Gunther Schadow, "Enabling Joint Commission Medication Reconciliation Objectives with the HL7/ ASTM Continuity of Care Document Standard", AMIA Symposium Proceedings, pp186-190, 2007.
[11] Klaus-Hendrik WOLF, Stephan SCHIRMER, Michael MARSCHOLLEK, Reinhold HAUX, "Representing Sensor Data Using the HL7 CDA Personal Healthcare Monitoring Report Draft", IOS Press, pp480-484, 2009.
[12] BENGISU TULU, THOMAS A. HORAN," The Electronic Disability Record: Purpose, Parameters, and Model Use Case", Journal of the American Medical Informatics Association, Vol. 16 No. 1, pp7-13 , 2009.
[13] Shobha Phansalkar, George Robinson, George Getty, James Shalaby, David Tao, Carol Broverman, "Challenges in Exchanging Medication Information: Identifying Gaps in Clinical Document Exchange and Terminology Standards", AMIA Symposium Proceedings, pp526-530, 2009.
[14] Chun-Chiao Huang, Der-Ming Liou, "The Study of Standard-Based Electronic Case Report Form Design System", IHIC Symposium Proceedings, 2009.